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[54] **DATA STORAGE LIBRARY WITH CARTRIDGE ACCESS MECHANISM**

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[51] **Int. Cl.**⁷ **G11B 15/68**

[52] **U.S. Cl.** **360/92**

[58] **Field of Search** 360/92; 369/36,
369/38, 178; 414/276

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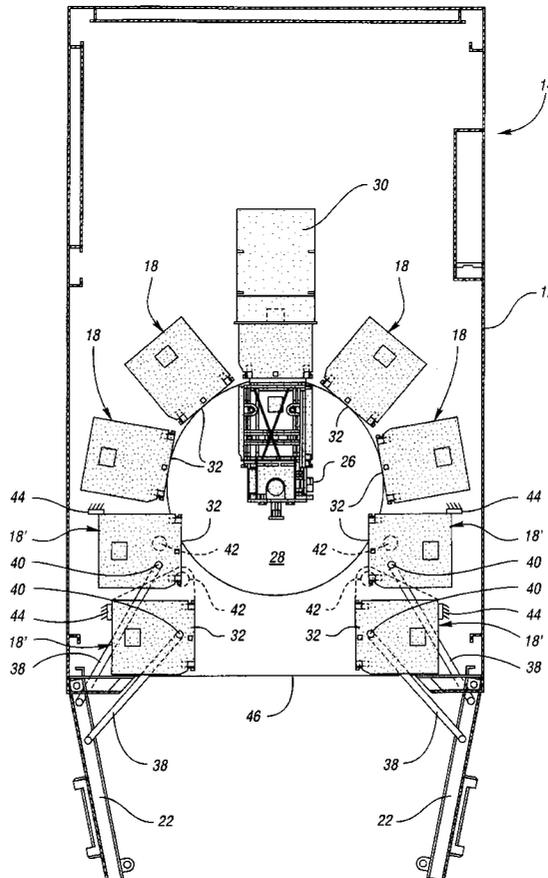
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[57] **ABSTRACT**

A data storage library is provided which comprises a housing with an access door provided therein. A plurality of cartridge storage arrays are mounted within the housing, wherein the front of each array is positioned to face an internal space of the housing, preferably occupied by a robotic arm. In this configuration, cartridges contained within the arrays are generally unable to be accessed by an operator. Of the plurality of cartridge storage arrays, at least one array is movable. A rotating mechanism is coupled to the movable array, and the rotating mechanism is operable to turn the movable array from a first position inside the housing and facing the internal space, to a second position inside the housing and facing at least partially away from the internal space, allowing cartridges contained within the plurality of cartridge storage arrays to be accessed by an operator through the access door. In a preferred embodiment, the rotating mechanism comprises a linkage arm pivotally connecting the access door to the movable array, wherein opening the access door rotates the linkage arm to turn the movable array from the first position to the second position.

3 Claims, 6 Drawing Sheets



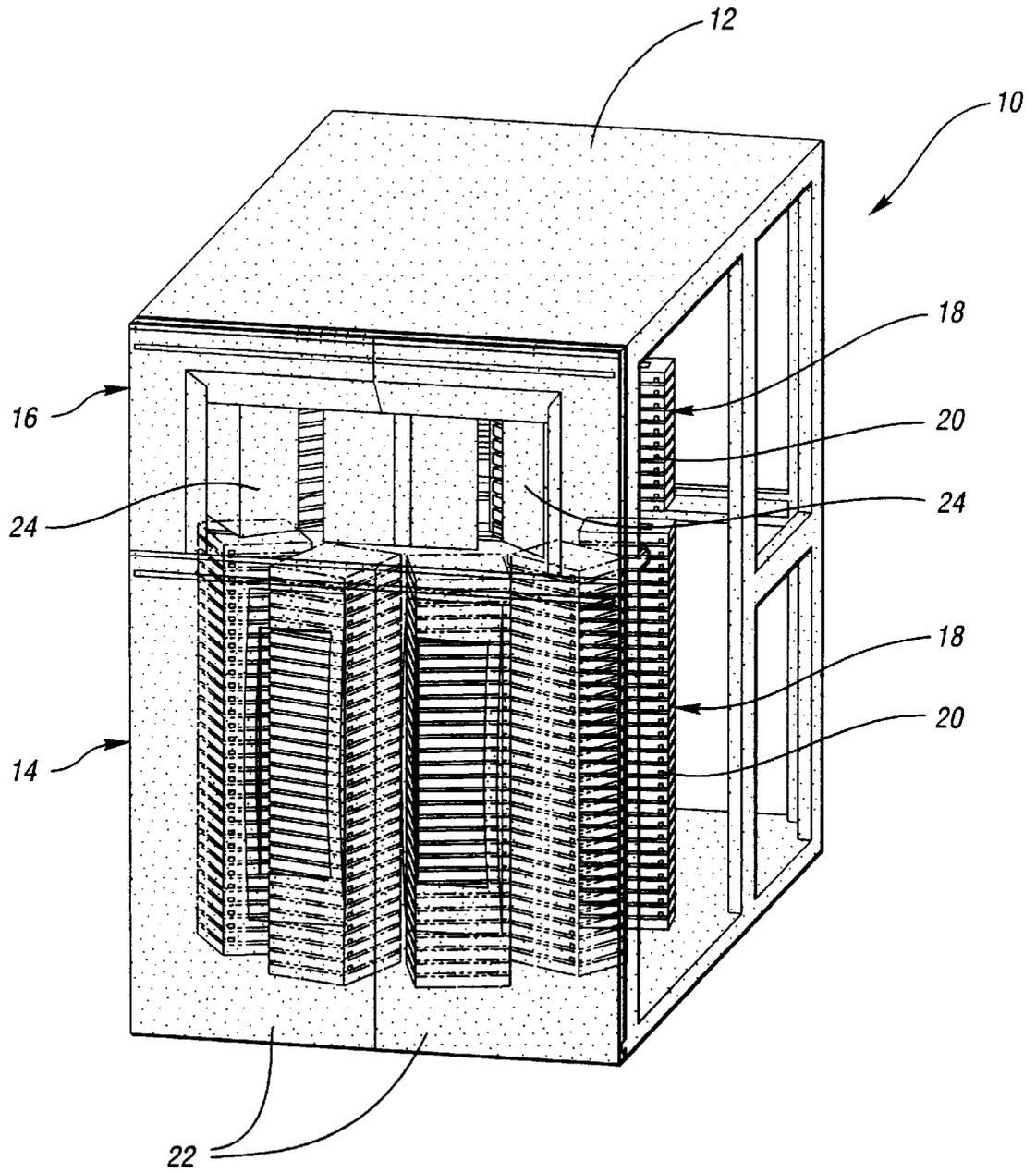


Fig. 1

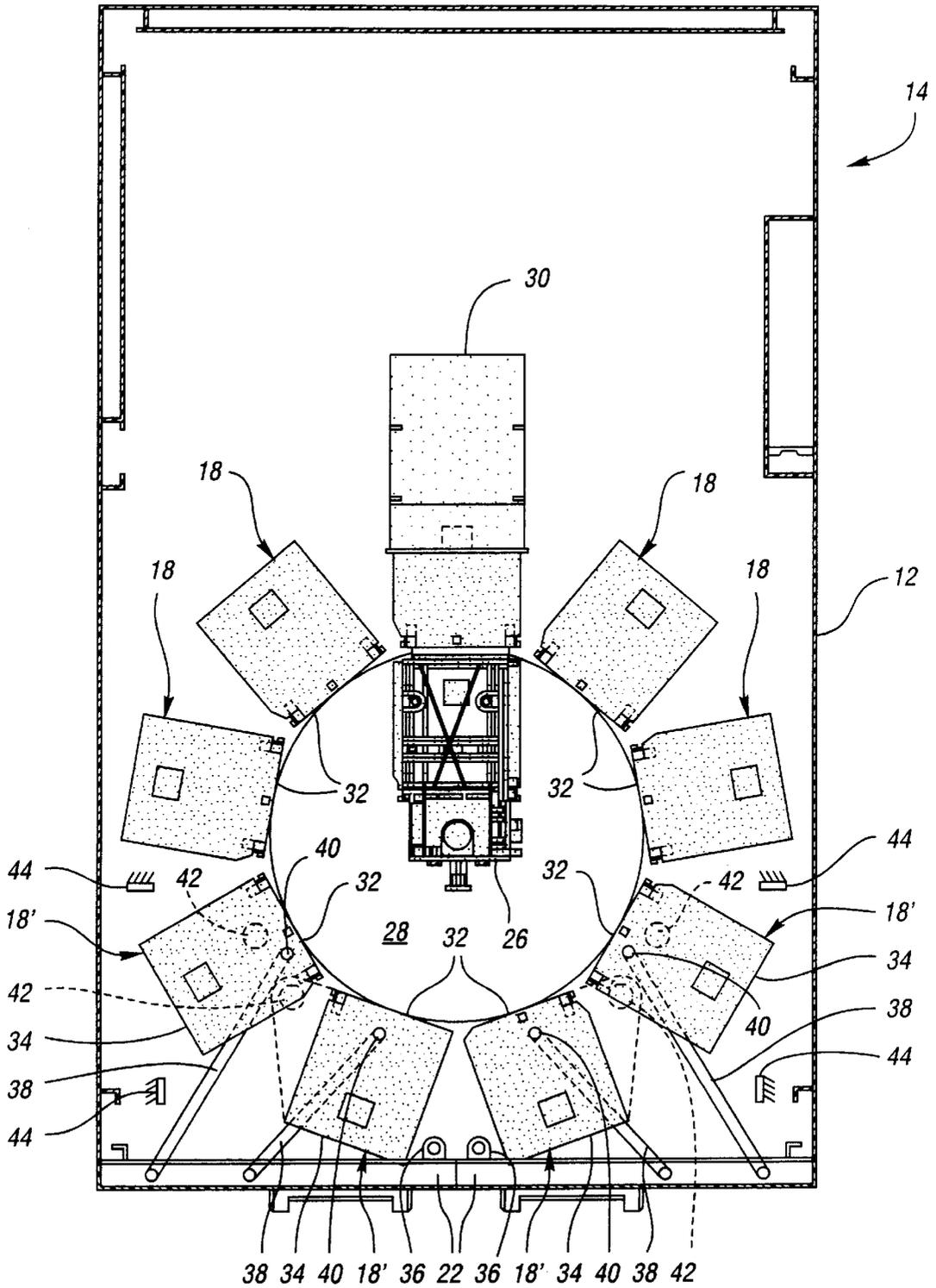


Fig. 2

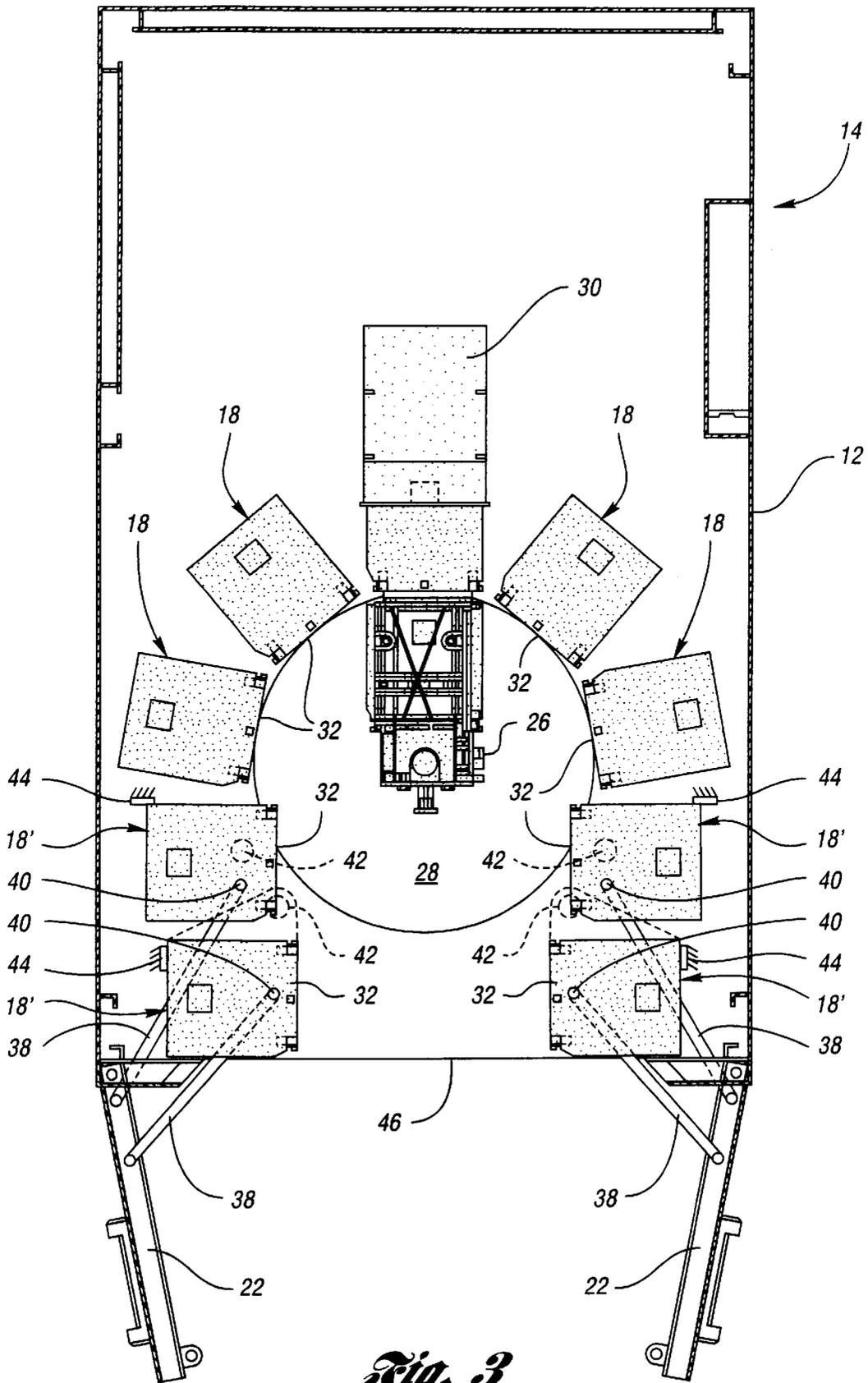


Fig. 3

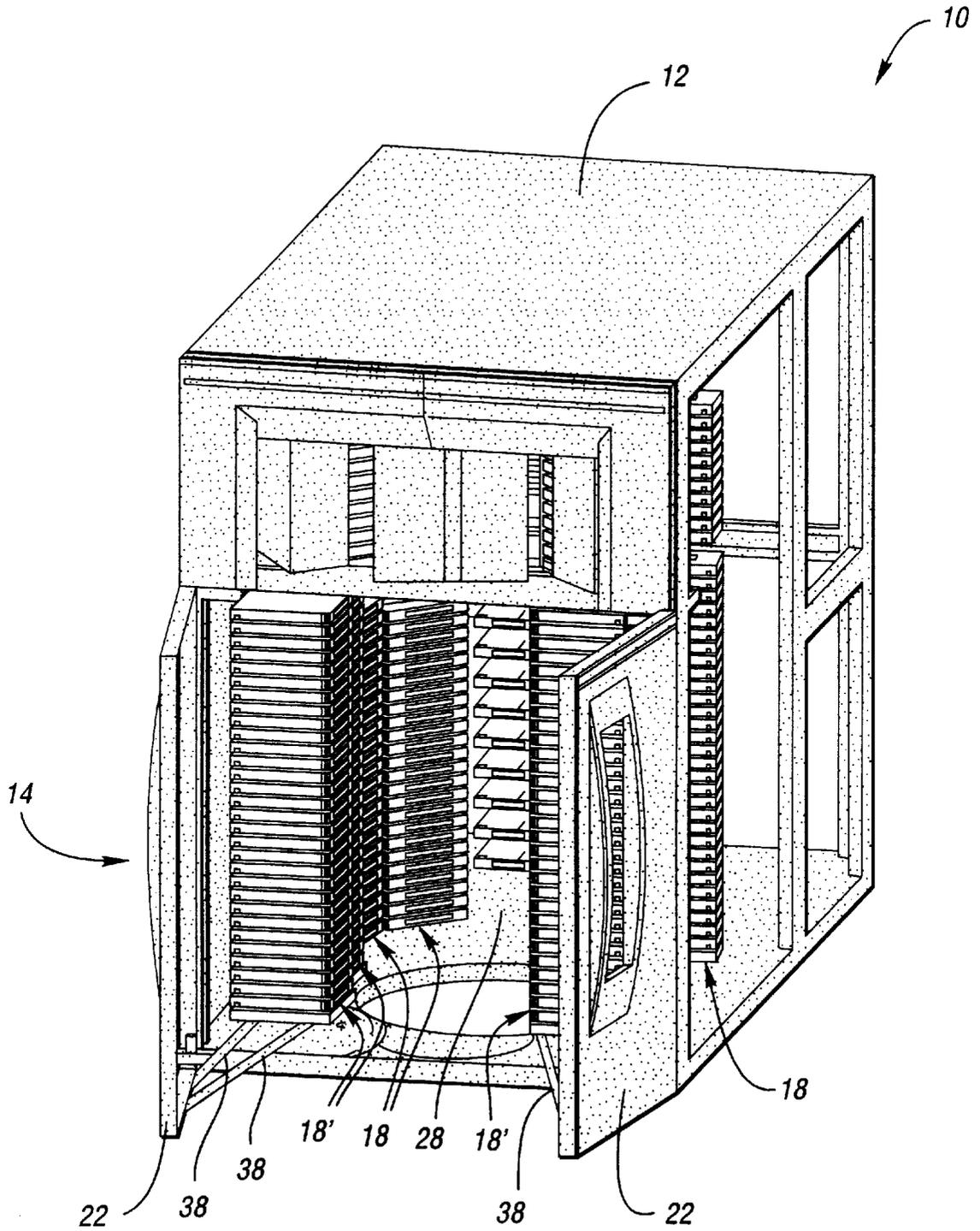


Fig. 4

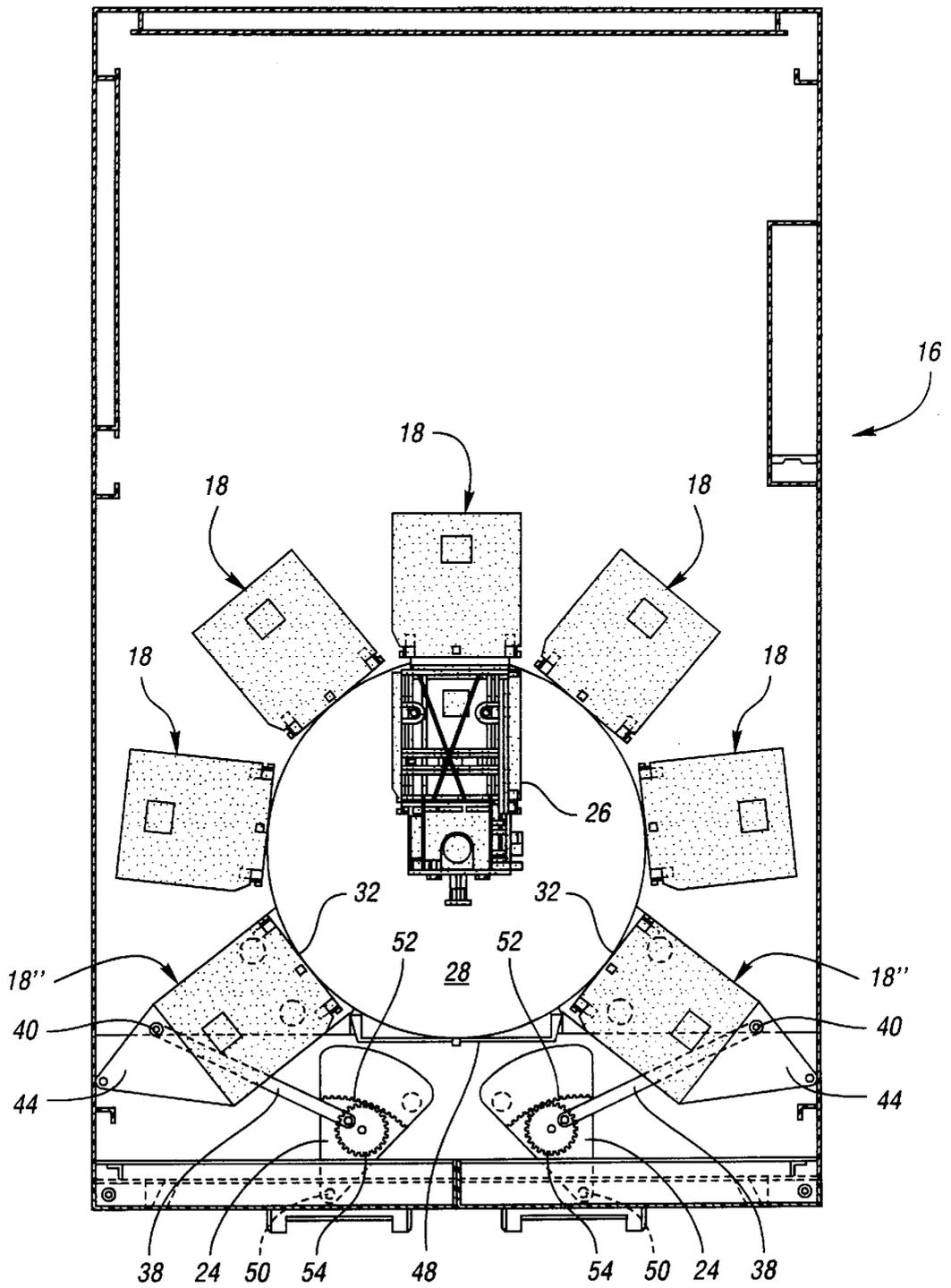


Fig. 5

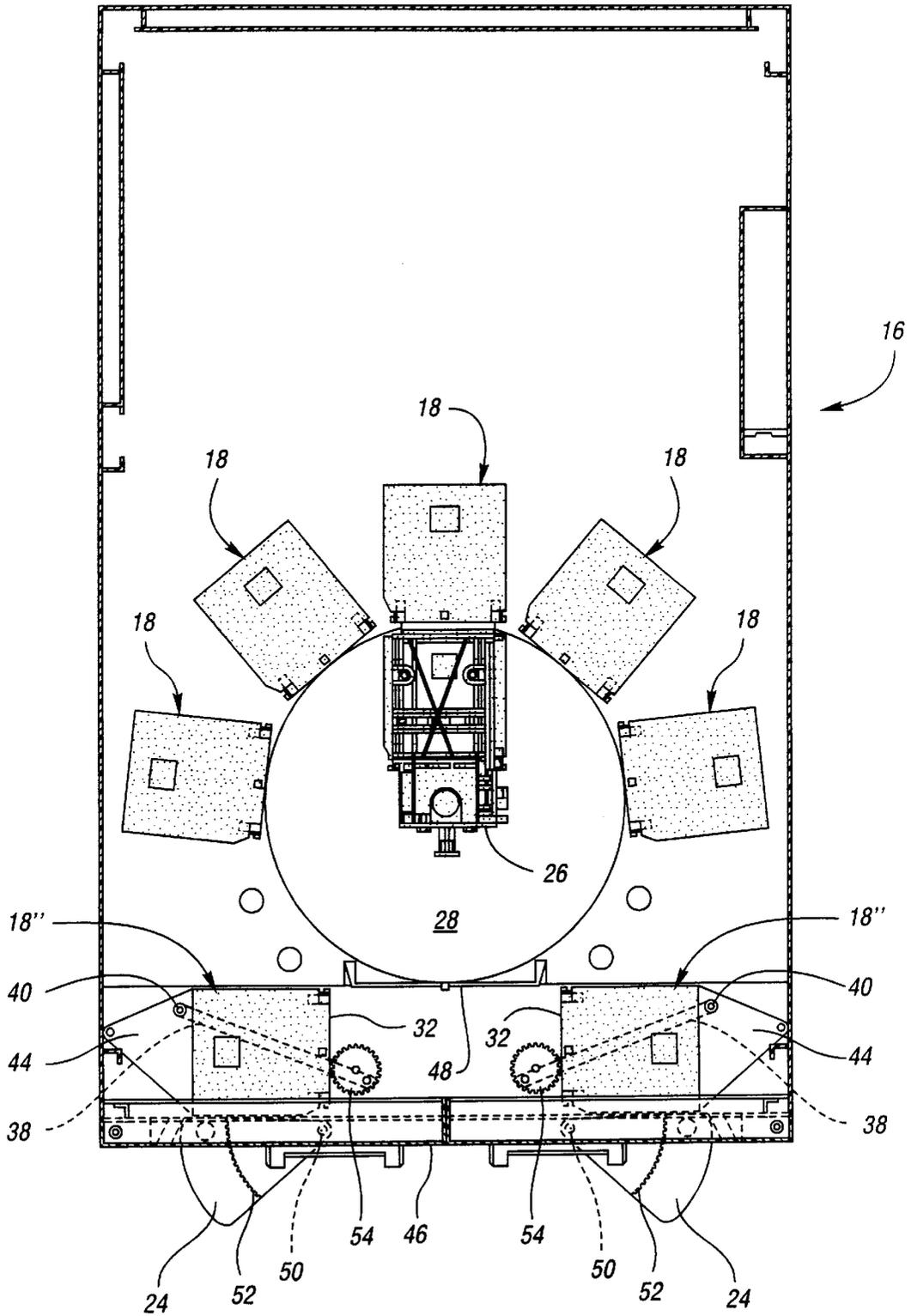


Fig. 6

DATA STORAGE LIBRARY WITH CARTRIDGE ACCESS MECHANISM

TECHNICAL FIELD

This invention relates to data storage libraries, and more particularly to a data storage library with a cartridge access mechanism for identifying, loading, and unloading cartridges maintained within the library.

BACKGROUND ART

A popular device for handling large amounts of information in a data processing system is the data storage library. These systems store and manage large numbers of cartridges containing magnetic tape on which data is recorded. Typically, a data storage library is comprised of arrays of uniquely identified storage cells, each cell being formed to contain a single tape cartridge. The cell arrays each hold a plurality of tape cartridges, and each tape cartridge has some kind of identifying information, such as a label or bar code. Typically, the arrays surround a robotic arm which has an optical system for selecting cartridges, and is operable to locate a particular storage cell and retrieve and transport a tape cartridge therefrom.

Given the large capacity of data storage libraries, there is a continual need for an operator to load and unload cartridges from the library. One conventional technique is to implement a small access port which consists of a bank of storage cells mounted to a panel which rotates out from the storage area to present itself to an operator on the outside of the library enclosure. This technique is time consuming, since the access port must be opened many times to accomplish a full capacity load. In addition, the storage capacity of the library is reduced by the number of fixed storage cells replaced by the panel. Furthermore, such an access port often requires additional, costly motorized components.

For mass loading and unloading of large numbers of cartridges, more direct access to the cartridges contained within the library, such as through an access door, is preferable. However, each array is usually positioned so that the front of the array, the side from which the cartridges may be identified and accessed, faces the robotic arm. Since the arrays are typically mounted in close proximity to each other and surrounding the robotic arm, the arrays adjacent the access door have their backs facing the operator, denying the operator access to the cartridges or visibility of the cartridge identification labels.

DISCLOSURE OF THE INVENTION

Therefore, it is an object of the present invention to provide a data storage library with a cartridge access mechanism which facilitates easy viewing and access of cartridges within the library.

It is another object of the present invention to provide a data storage library with a cartridge access mechanism which allows for convenient mass loading and unloading of cartridges.

It is another object of the present invention to provide a cartridge access mechanism which minimizes the loss of storage capacity in the data storage library.

It is another object of the present invention to provide a cartridge access mechanism that operates reliably within a data storage library without the need for additional motors and associated electronics.

Accordingly, a data storage library is provided which comprises a housing with an access door provided therein.

A plurality of cartridge storage arrays are mounted within the housing, wherein the front of each array is positioned to face an internal space of the housing, preferably occupied by a robotic arm. In this configuration, cartridges contained within the arrays are generally unable to be accessed by an operator. Of the plurality of cartridge storage arrays, at least one array is movable. A rotating mechanism is coupled to the movable array, and the rotating mechanism is operable to turn the movable array from a first position inside the housing and facing the internal space, to a second position inside the housing and facing at least partially away from the internal space, allowing cartridges contained within the plurality of cartridge storage arrays to be accessed by the operator through the access door. In a preferred embodiment, the rotating mechanism comprises a linkage arm pivotally connecting the access door to the movable array, wherein opening the access door rotates the linkage arm to turn the movable array from the first position to the second position.

The above objects and other objects, features, and advantages of the present invention are more readily understood from a review of the attached drawings and the accompanying specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a data storage library in accordance with the present invention;

FIG. 2 is a top, sectional view of a lower section of the data storage library of the present invention shown with the main access doors closed;

FIG. 3 is a top, sectional view of the lower section of the data storage library of the present invention shown with the main access doors open;

FIG. 4 is a perspective view of the data storage library of the present invention shown with the main access doors open;

FIG. 5 is a top, sectional view of an upper section of the data storage library of the present invention shown with the limited access doors closed; and

FIG. 6 is a top, sectional view of the upper section of the data storage library of the present invention shown with the limited access doors open.

BEST MODES FOR CARRYING OUT THE INVENTION

Referring first to FIG. 1, a data storage library 10 is indicated generally by reference numeral 10. Data storage library 10 is provided with a suitable housing 12 to ensure operator safety and data security. In a preferred embodiment, library 10 includes a lower section 14 and an upper section 16. As shown, data storage library 10 contains a plurality of arrays 18, wherein each array 18 consists of a plurality of individual storage cells 20 sized to hold tape cartridges (not shown). Given the large capacity of data storage library 10, loading and unloading of cartridges from library 10 is often done by an operator on a daily basis. Typically, lower section 14 of library 10 is utilized for mass access of cartridges stored therein, while upper section 16 is restricted to more limited cartridge access. Upper section 16 is often referred to as a cartridge access port (CAP). In data storage library 10 of the present invention, main access doors 22 are provided in lower section 14, and limited access doors 24 are provided in upper section 16. The function of doors 22 and 24 in providing cartridge access will be described below.

FIGS. 2-6 show views of lower 14 and upper 16 sections of data storage library 10. As shown, library 10 contains a

plurality of cartridge storage arrays **18** mounted to surround an actuator, such as a robotic arm **26**. Arrays **18** may be mounted in either a permanent or a removable manner within library **10**. Although a circular arrangement of storage arrays **18** is depicted herein, the present invention applies equally well to libraries utilizing other storage configurations and housing structures. Preferably, the operation of library **10** is automated and is directed by a processor, such as a host computer (not shown). The processor provides signals to robotic arm **26**, to control its motion and operation, and therefore control the handling and storage of cartridges within data storage library **10**. Robotic arm **26** is disposed within the internal space **28** of library **10** not occupied by arrays **18**. The processor also controls the operation of an optional tape drive **30** located within data storage library **10**.

As shown in the top, sectional view of lower section **14** of library **10** depicted in FIG. **2**, each array **18** is usually positioned so that its front **32**, the side from which cartridges may be identified and accessed, faces robotic arm **26**. Since arrays **18** are typically mounted in close proximity to each other and surrounding robotic arm **26**, arrays **18'** adjacent main access doors **22** have their backs **34** facing the operator. As described below, the present invention provides visibility and access to the cartridges in all storage arrays **18** and **18'** by allowing at least one of the adjacent arrays **18'** to move when main access doors **22** are opened. In the preferred embodiment, all four arrays **18'** are movable.

As in any typical library enclosure, data storage library **10** is made secure by providing locks **36** for main access doors **22**. Locks **36** preferably comprise simple cabinet latches, with a spring-loaded plunger provided on each main access door **22**, and mating holes provided in latch plates affixed to the interior of housing **12**. Alternatively, electric latches, similar to those used in the automotive industry, could be used to lock main access doors **22** until an electrical signal from the processor is supplied. Additionally, the present invention utilizes locks **36** to latch movable arrays **18'** in a first, closed position facing internal space **28** when main access doors **22** are closed.

Referring now to FIGS. **2** and **3**, movable arrays **18'** are pivotally mounted to housing **12**. A rotating mechanism is coupled to each movable array **18'**, wherein the rotating mechanism is operable to turn movable arrays **18'** from their first, closed position (FIG. **2**) inside housing **12** and facing internal space **28** to a second, open position (FIG. **3**) inside housing **12** and facing at least partially away from internal space **28**. Once movable arrays **18'** are in their open position, cartridges contained within the plurality of cartridge storage arrays **18** may be easily viewed and accessed by an operator through main access doors **22**.

In the preferred embodiment, the rotating mechanism comprises linkage arms **38**. Linkage arms **38** are pivotally connected at one end to a main access door **22**, and at the other end to a pivot joint **40** built into the bottom of each movable array **18'**. As shown in FIG. **3**, linkage arms **38** cause any rotation of main access doors **22** to reflect a similar rotation of movable arrays **18'**. Pivot axles **42** are affixed to the end of each movable array **18'**, and are located to allow movable arrays **18'** to rotate between accurate closed positions and optimum open positions for operator access. Stops **44** affixed inside housing **12** establish the open position of movable arrays **18'** and limit the swing of main access doors **22**. Preferably, as shown in FIGS. **3** and **4**, movable arrays **18'** rotate to an angle where the plane of the front **32** of each array **18'** is normal to the front **46** of housing **12**, such that the front of two of movable arrays **18'** face the

front of the other two movable arrays **18'**. Of course, rotating mechanisms other than linkage arms **38** could be utilized in the present invention to rotate movable arrays **18'**.

Although both main access doors **22** are shown in the open position in FIG. **3**, the cartridge access mechanism of the present invention does not require both doors **22** to be open to function properly. Each of main access doors **22** functions independently, so that either side of library **10** may be accessed individually without the need for opening both doors **22**. In an alternative embodiment, only one main access door **22** may be provided.

Therefore, the present invention provides a data storage library **10** with a cartridge access mechanism which facilitates easy viewing and access of cartridges within the library **10**. The data storage library of the present invention preserves library storage capacity by using existing storage arrays **18'** as a cartridge access mechanism instead of reducing library space with a separate loading device. In addition, mass loading and unloading of cartridges from library **10** may be accomplished conveniently through main access doors **22**. Movable arrays **18'** are rotated within housing **12** and do not protrude out of housing **12**, thereby providing a compact access mechanism. Furthermore, additional motorized components are not required, as simple mechanical linkage arms **38** are utilized to rotate movable arrays **18'**.

In an alternative embodiment of the present invention, a more limited cartridge access mechanism is implemented. In this embodiment, depicted in the top, sectional views of upper section **16** of library **10** shown in FIGS. **5** and **6**, the rotating mechanism only allows manual access to selected arrays **18''** in data storage library **10**. Upper section **16** includes an operator shield, such as stationary baffles **48**, to deny access to internal space **28** where robotic arm **26** may be working. Therefore, robotic arm **26** may continue to work even when limited access doors **24** are opened.

Preferably, linkage arms **38** are again used as the rotating mechanism, although other rotating mechanisms could be utilized. Linkage arms **38** are connected to on one end to a limited access door **24**, and on the other end to a pivot joint **40** provided on each array **18''** adjacent limited access doors **24**. Arrays **18''** are pivotally mounted within housing **12** via pivot axles **42**. FIG. **5** shows limited access doors **24** in a first, closed position, which prevents access to movable arrays **18''**. In FIG. **6**, limited access doors **24** have been rotated manually about vertical pivot axes **50**, which in turn rotates movable arrays **18''** to a second, open position. Movable arrays **18''** are mounted so that upon rotation, they do not interfere with baffles **48**.

In upper section **16**, linkage arms **38** are made operable by sector gears **52** formed into the bottom of each limited access door **24**. Sector gears **52** are mated with spur gears **54** which are rotatably mounted to the interior of upper section **16**. This mating drives spur gears **54** to rotate only for a partial rotation of limited access doors **24**. Therefore, while limited access doors **24** are allowed to open until they are out of contact with sector gears **52** and in an open position against the front **46** of housing **12**, movable arrays **18''** have a much more limited rotation. As shown in FIG. **6**, movable arrays **18''** rotate to face each other, such that the plane of the front **32** of each array **18''** is at an angle normal to the front **46** of housing **12**. In this manner, manual operation of limited access doors **24**, acting with stationary baffles **48**, prevents access to other arrays **18** or robotic arm **26** at all times. As described for lower section **14**, the open and closed positions of the limited access doors **24** and arrays **18''** are controlled by locks **36** and stops **44**.

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It is understood, of course, that while the form of the invention herein shown and described constitutes a preferred embodiment of the invention, it is not intended to illustrate all possible forms thereof. It will also be understood that the words used are words of description rather than limitation, and that various changes may be made without departing from the spirit and scope of the invention disclosed.

What is claimed is:

- 1. A data storage library comprising:
 - a housing;
 - an access door provided in the housing;
 - a plurality of cartridge storage arrays mounted within the housing, the front of each array positioned to face an internal space in the housing such that cartridges contained within the storage arrays are generally unable to be accessed by an operator, wherein at least one of the arrays is movable; and
 - a rotating mechanism coupled to the at least one movable array, wherein the rotating mechanism is operable to turn the at least one movable array from a first position inside the housing and facing the internal space, to a second position inside the housing and facing at least partially away from the internal space, allowing cartridges contained within the plurality of cartridge storage arrays to be accessed by an operator through the access door, wherein the rotating mechanism is actuated by opening the access door.
- 2. A data storage library comprising:
 - a housing;
 - an access door provided in the housing;
 - a plurality of cartridge storage arrays mounted within the housings, the front of each array positioned to face an internal space in the housing such that cartridges contained within the storage arrays are generally unable to

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- be accessed by an operator, wherein at least one of the arrays is movable;
- a rotating mechanism coupled to the at least one movable array, wherein the rotating mechanism is operable to turn the at least one movable array from a first position inside the housing and facing the internal space, to a second position inside the housing and facing at least partially away from the internal space, allowing cartridges contained within the plurality of cartridge storage arrays to be accessed by an operator through the access door, wherein the rotating mechanism comprises a linkage arm connecting the access door to the at least one movable array.
- 3. An automated data storage library comprising:
 - a housing;
 - an access door provided in the housing;
 - a robotic arm affixed within an internal space of the housing;
 - a plurality of cartridge storage arrays mounted within the housing, the front of each array positioned to face the robotic arm such that cartridges contained within the arrays are generally unable to be accessed by an operator, wherein at least one of the arrays is movable; and
 - a linkage arm pivotally connecting the access door to the at least one movable array, wherein opening the access door rotates the linkage arm to turn the at least one movable array to from a first position inside the housing and facing the robotic arm, to a second position inside the housing and facing at least partially away from the robotic arm, allowing cartridges contained within the plurality of cartridge storage arrays to be accessed by an operator.

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